There is evidence that optically stimulated luminescence (OSL) dating of quartz using the single-aliquot regenerative-dose (SAR) protocol underestimates the equivalent dose \( (D_e) \) for paleodoses above 100–200 Gy. Additionally, ‘infinitely’ old samples found not to be in laboratory saturation were reported. We present single and multi-grain SAR-OSL investigations for a coarse-grained (180–250 \( \mu \text{m} \)) quartz sample extracted from loess collected below the Brunhes/Matuyama transition at the Roksolany site (Ukraine). The sample was dated to more than 1000 ka by electron spin resonance using a multi center approach (Al and Ti signals), confirming that the \( D_e \) (\( \sim 2000 \) Gy) falls beyond the limit of standard OSL \( D_e \) measurement techniques. However, the natural signal measured using multi-grain aliquots of quartz was found to be below the laboratory saturation level. A comparison was made between synthetic dose response curves (DRCs) generated from single-grain and multigrain aliquot data, respectively; the natural signal was found to be closer to the laboratory saturation level (92%) in the case of the single-grain synthetic DRC than for the multi-grain synthetic DRC where the signal was 86% of the saturation level. This difference could not be attributed to stimulation with different wavelengths, i.e. blue and green light stimulation for multi and single-grain measurements, respectively. By analysing synthetic data obtained by grouping grains according to their brightness, it was observed that brighter grains give a natural signal closer to the laboratory saturation level. This trend was confirmed for multi-grain aliquot data. Based on these findings we infer that variability in the contribution from populations of grains with different levels of brightness may represent a controlling factor in the closeness of the natural signal to laboratory saturation level for infinitely old samples.

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